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CURRICULUM GUIDE

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# CURRICULUM GUIDE

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## ACKNOWLEDGEMENTS

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NOTE: This curriculum guide is a *service publication only*. The Junior High School Program of Studies contains the official statement concerning the Junior High Science. The information contained in this guide is prescriptive insofar as it duplicates that which is in the Program of Studies.

## OBJECTIVES OF SECONDARY SCHOOL SCIENCE FOR ALBERTA

The learning of science as an area of human endeavour, should provide the student with a scientific literacy which enables him to assume an active and useful role as a citizen in a democratic society. It may be assumed that this literacy is best achieved by considering the individual needs of students and through independent study and learning.

The objectives of Secondary School Science are:

1. To promote an understanding of the role that science has had in the development of societies:
  - a. history and philosophy of science as part of human history and philosophy
  - b. interaction of science and technology
  - c. effect of science on health, population growth and distribution, development of resources, communication and transportation, etc.
2. To promote an awareness of the humanistic implications of science:
  - a. moral and ethical problems in the use and misuse of science
  - b. science for leisure-time activities.
3. To develop a critical understanding of those current social problems which have a significant scientific component in terms of their cause and/or their solution:
  - a. depletion of natural resources
  - b. pollution of water and air
  - c. overpopulation
  - d. improper use of chemicals
  - e. science for the consumer

4. To promote understanding of and development of skill in the methods used by scientists:
  - a. processes in scientific inquiry such as observing, hypothesizing, classifying, experimenting and interpreting data
  - b. intellectual abilities such as intuition, rational thinking, creativity, and critical thinking
  - c. skills such as manipulation of materials, communication, solving problems in groups, and leadership.
5. To promote assimilation of scientific knowledge:
  - a. emphasis on fundamental ideas
  - b. relevance of scientific knowledge through inclusion of practical applications
  - c. applications of mathematics in science
  - d. interrelationships between the sciences
  - e. open-endedness of science and the tentativeness of scientific knowledge.
6. To develop attitudes, interests, values, appreciations, and adjustments similar to those exhibited by scientists at work.
7. To contribute to the development of vocational knowledge and skill:
  - a. science as a vocation
  - b. science as background to technical, professional and other vocations.



## PHILOSOPHY AND GOALS OF THE JUNIOR HIGH SCIENCE PROGRAM

- A. The paramount goal is the student's understanding of the natural world. While understanding cannot be developed in the absence of supporting facts, the memorization of unwarranted detail is to be avoided. However, mastery of a limited number of technical terms is essential for precise communication. The objective is to help in the development of an individual who is aware, informed and concerned about the natural world.
- B. The courses are designed to make the student familiar with his natural environment and interrelationships that exist in this environment. Every student should be given the opportunity to pursue investigative activities, and adequate facilities and opportunities should be provided for these activities.



- C. Although recommended texts are listed for each course, it is suggested that teachers also make use of the secondary reference list to develop units of study. It is recommended that teachers exercise professional judgment in ordering references for the school library.
- D. The Junior High Science program continues to emphasize skills, concepts, attitudes, and humanistic and social implications of science which have been developed in the elementary program.



Content is therefore significant only to the degree that it provides for the realization of other objectives of the program. Student interest should be a significant criterion in the selection of learning experiences.

- E. The Junior High Science program further develops, in the context of Life, Earth, and Physical science, the six conceptual schemes outlined for the Elementary Science program:
- I. When energy changes from one form to another, the total amount of energy remains *constant*.
  - II. When matter changes from one form to another, the total amount remains *constant*.
  - III. Living things are interdependent with one another and with their environment.
  - IV. A living thing is the product of its heredity and environment.
  - V. Living things are in constant change.
  - VI. The universe, and its component bodies, are constantly changing.

The Junior High Science program attempts to provide a background of basic science knowledge for students who may pursue a wide variety of programs, both formal and informal, once they leave grade nine. It is not the intent that students be prepared for any one program but rather that they be encouraged to explore as widely as possible in response to their interests within the general outline of the program.

## MAJOR OBJECTIVES OF JUNIOR HIGH SCIENCE

1. To develop student awareness of the humanistic and social implications of science. The student should study issues such as these:
  - a. evaluation of commercial messages
  - b. depletion of non-renewable resources
  - c. use and misuse of scientific discoveries.
2. To develop the student's ability to understand and appreciate the nature of science and his role as an investigator and learner. The student should develop:
  - a. science process skills
  - b. communication skills
  - c. interpretative and computational skills based on collected data.
3. To develop student attitudes, interests, values, appreciations and adjustments similar to those exhibited by scientists at work. This may be achieved by involving the student in:
  - a. an active program of field experiences
  - b. a program of bringing items to the classroom
  - c. the use of resource people in the classroom.
4. To have the student develop basic concepts in Life, Earth and Physical science. In the development of these concepts the student should have practice in:
  - a. interpreting and evaluating fundamental ideas
  - b. relating scientific knowledge to practical everyday life
  - c. dealing with concepts which illustrate the sometimes tentative nature of science knowledge.
5. To have the student develop basic skills of, and attitudes toward safe practices.

## SKILLS TO BE DEVELOPED IN SCIENCE

### 1. PROCESS SKILLS

A key objective of the Junior High Science program is to make the student an increasingly active and dynamic investigator of Science--using the processes of the scientist. Through conscious, systematic development of these processes, the student becomes increasingly better equipped for more complex learning in the fields of science as well as in other areas of investigation.

The following processes are considered to be an essential part of the student's learning:

- (a) Observing--using all the senses
- (b) Classifying--grouping related objects or ideas
- (c) Quantifying--using numbers and measurements
- (d) Communicating--using such means as discussion, tabulation, graphing...
- (e) Inferring
- (f) Predicting
- (g) Formulating hypotheses
- (h) Defining terms
- (i) Controlling variables
- (j) Interpreting data and results
- (k) Formulating models--verbal, pictorial, and concrete
- (l) Experimenting--planning and designing an investigation
- (m) Processing of data--organizing, representing graphically, treating mathematically
- (n) Identifying problems
- (o) Seeking further evidence
- (p) Applying discovered knowledge

Some of these processes may be developed in the following manner.\*

<u>Process</u>	<u>Description of Behavior</u>	<u>Example Activities</u>
OBSERVING	The desired pupil behavior is increasing competence in using not only his sense of sight but also his other senses of hearing, touch, smell and taste.	<i>These may involve both oral and written descriptions of the following: Identify and name colours, textures, relative sizes and other properties of objects. Distinguish difference in temperature, read</i>

\*AAAS, *Commentary for Teachers*. American Association for the Advancement of Science.

<u>Process</u>	<u>Description of Behavior</u>	<u>Example Activities</u>
		<i>temperature on a thermometer, identify and name factors in weather such as temperature and precipitation; identify possible causes of change, such as heat, wind and air pressure, show the effect or cause of change on an object such as a balloon; describe selected items so that others can identify and name the main parts of a plant; describe plant growth over a period of time; describe the relationship between two variables.</i>
CLASSIFYING	The desired pupil behavior is increasing competence in grouping articles, objects and ideas on the basis of some observable property or properties.	<i>Objects may be classified according to smoothness, texture, color, and special characteristics. Single-stage classifications are followed by two-stage and multi-stage classifications.</i>
QUANTIFYING	The desired pupil behavior is increasing competence in measuring length, weight, area, volume, and rate of change of the physical world.	<i>The following are illustrative: Distinguish objects by using such terms as heavier and lighter; identify relative weight by lifting; use a balance to distinguish heavier from lighter objects; use standard units of weight; explain effects of gravitation and inertia; measure the weight of various objects; describe differences in weights; identify, state and demonstrate differences in perception of weight.</i>
FORMULATING HYPOTHESES	The desired pupil behavior involves developing increasing competence in stating an hypothesis regarding	<i>The following illustrate hypotheses: 1. If the air pressure inside is less than the air pressure outside a</i>

<u>Process</u>	<u>Description of Behavior</u>	<u>Example Activities</u>
	causes of phenomenon or the relationship between two variables. An hypothesis tells how to observe an expected outcome of an experiment.	<i>tube, then water will rise in the tube.</i> 2. <i>If a ball is dropped, its speed will increase as it approaches the floor.</i>
MAKING OPERATIONAL DEFINITIONS	The pupil should demonstrate increasing competence in stating the minimum things to do or look for in order to identify the subject being defined.	<i>The following are illustrative: Cold means 15°C for this experiment; little friction means that not more than an additional 10% of force over and above the weight of the object is required to move the object across a surface.</i>
CONTROLLING AND MANIPULATING VARIABLES	The desired pupil behavior is increasing competence in arranging conditions to be able to deliberately control and manipulate objects or conditions in an experiment.	<i>The following examples are illustrative:</i> 1. <i>Consider two pendula swinging at different rates. Variables to control might include: the weights (size, shape, and mass), the string (length and thickness), and the length of swing.</i> 2. <i>Metals expand when heated. Variables to control might include: kind of metal and the temperature.</i>
INTERPRETING DATA	The desired pupil behavior is increasing competence in getting the most out of data without oversimplifying, drawing conclusions supported by the data, and considering alternative explanations.	<i>Interpretations may be made of observations made in the form of verbal statements, graphs, histograms and tables.</i>



<u>Process</u>	<u>Description of Behavior</u>	<u>Example Activities</u>
FORMULATING MODELS	The desired pupil behavior is increasing competence in building both physical and mental models to account for phenomena.	<p><i>The following models are illustrative:</i></p> <ol style="list-style-type: none"> <li>1. Pictures of the moon's surface</li> <li>2. Diagrams of the life cycle of an insect</li> <li>3. Physical model of a chromosome</li> <li>4. Mental model--idea of an atom.</li> </ol>
COMMUNICATING	The desired pupil behavior is increasing competence in describing an experiment so that an individual who has not seen it can carry it out.	<p><i>Experiences in identifying and naming objects are followed by graphing and describing measured changes as shown in the following examples:</i></p> <p><i>Identify and name events that can be quantified, such as five bounces of a ball; make a column in a bar graph to represent the frequency of an event; distinguish events shown in a graph; make a bar graph; describe measured changes in speed, temperature, and other properties, make a prediction on the basis of recorded measures; make a graph to show the prediction; describe an experiment so that others might do it.</i></p>
INFERRING	The desired pupil behavior is increasing competence in drawing more than one inference from a set of data, demonstrating that inference can be tested by further observation, and demonstrating that an inference can be tested by applying known tests to the	<p><i>The following sequence is illustrative. Use the concept "evaporation" to explain how water is lost by plants; demonstrate a way to measure the water used by a plant; infer and demonstrate that water drawn through plants is transferred to the atmosphere; show that an inference may be tested by additional observations.</i></p>



<u>Process</u>	<u>Description of Behavior</u>	<u>Example Activities</u>
	properties of objects. Pupils should indicate that they are able to distinguish between observations and inferences.	
PREDICTING	The desired pupil behavior is increasing competence in conducting experiments to test predictions of relationships between two measurable quantities.	<i>Various tasks might include: plotting data, making and interpreting graphs, and observing from different vantage points. For example, analyze a graph to determine the pattern relationships (increasing, decreasing, stable); use a graph to predict water loss from plants; make predictions from a series of observations by means of graphs; conduct an experiment to test predictions.</i>
EXPERIMENTING	The desired pupil behavior is increasing competence in planning, conducting and communicating experiments in which the problem is clarified, hypotheses are stated, observations are made, and data interpreted. This process depends upon the pupil being able to use all of the other processes.	<i>Pupils might develop experiments to answer the following questions:</i> <ol style="list-style-type: none"><li><i>1. How do mealworms react to light?</i></li><li><i>2. How many nails can a magnet lift?</i></li><li><i>3. What happens to salt when it is placed in water? Does more salt dissolve in water at 35°C than at 20°C?</i></li></ol>

## 2. MOTOR SKILLS

In order to develop manipulative skills, students in Junior High Science must have frequent opportunities for first-hand investigative experiences that involve the handling of materials and equipment.

### ATTITUDES TO BE DEVELOPED

Much of the spirit and meaning of science is transmitted to students from the teacher. Some of the attitudes the teacher should endeavor to develop in students are:

1. Curiosity and interest
2. Intellectual honesty
3. Open-mindedness
4. Belief in cause-effect relationships
5. Suspended judgment when data inadequate
6. A respect for accuracy and precision
7. Skepticism of statements which may be biased or based on inadequate information.



## CONTROVERSIAL ISSUES IN THE CLASSROOM

The presentation of issues of a potentially sensitive nature such as those related to human reproduction, special creation, or genetic manipulation are to be dealt with in accordance with the 1972 policy statement included as an appendix to this guide.

The intent of the policy statement is to develop student's capacities to think clearly, reason logically, and examine issues objectively. In pursuit of this, students should examine an issue from several points of view. In addition, care should be taken that theories are not presented as fact.

## LOCAL SELECTION OF INSTRUCTIONAL MATERIALS

Teachers are reminded that they are responsible to their employing boards for the classroom use of materials that are not prescribed by either the Department of Education or by the school board. The procedures to be used in seeking authorization to use other than prescribed references are described in the 1975 bulletin describing changes in legislation relative to local selection of instructional materials and development of curricula.





# **LIFE SCIENCE**





## Grade Seven

### Prescribed References:

Carter, J. L. et al, *Life Sciences: A Problem Solving Approach*.  
Scarborough: Ginn & Co., 1977

Smallwood, W. L., *Challenges to Science: Life Science*.  
Scarborough: McGraw-Hill, 1976

Objectives: After participating in the activities and completing the assignments associated with this course, the student should be able to:

- 7.1 Demonstrate a knowledge of and be able to discuss the identified major concepts and their subconcepts within the context of a study of life science. These major concepts are:
  - 7.1.1 All sets of objects including living things may be classified into groups having common characteristics.
  - 7.1.2 Cells are the unit of structure and function of most living things.
  - 7.1.3 Living things carry on certain fundamental processes to sustain and perpetuate life.
  - 7.1.4 All living things interact with and are interdependent upon each other and their environment.
- 7.2 Acquire such investigative skills associated with science as:
  - Observing with all the senses
  - Classifying related objects or ideas
  - Quantifying measured data
  - Manipulating data to identify the patterns
  - Identifying problems clearly so that the variables may be controlled or manipulated
  - Interpreting data, making inferences leading to hypotheses and predicting future behaviour.
- 7.3 Identify and discuss the limitations of experimental data in terms of the underlying assumptions and the identified problem.
- 7.4 Assume a responsibility for keeping the workspace neat and tidy by practicing safe, and careful, work habits.

- 7.5 Recognize and be able to cite examples of the contributions made by such historical figures as Robert Hooke, Louis Pasteur.
- 7.6 Investigate factors related to the wise use of renewable resources and man's impact upon the environment.

### CONCEPTS TO BE DEVELOPED

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- 7.1 All sets of objects including living things may be classified into groups having common characteristics.
  - 1. Classification makes thinking about a large number of things simpler and easier.
    - Within large groups, members share some common characteristics; within smaller subgroups, members share a greater number of common characteristics.
  - 2. An international system of classifying living things has been developed to facilitate the organization and exchange of knowledge of living things.
    - Living things may be classified as protist, plant or animal.
  - 3. A simple key may be used to facilitate identification of organisms.
- 7.2 Cells are the unit of structure and function of most living things.
  - 1. The techniques and tools of scientists aid in observing things (e.g. microscopes, balances, etc.)
  - 2. Plant and animal cells share many common characteristics.
  - 3. Cells live independently or in groups.
    - a. Single-celled organisms perform all the functions necessary for life.
    - b. Some cells in multi-cellular organisms are specialized to carry out specific functions.

7.3 Living things  
carry on certain  
fundamental pro-  
cesses in order  
to sustain life.

1. Organisms require nutrients for energy.
  - a. Green plants are the primary producers of food (photosynthesis).
  - b. Digestion is the process of breaking down food.
  - c. There is a chain of food and energy from primary producers to consumers to decomposers.
2. All living things obtain their energy from *respiration*.
  - a. Respiration is the oxidation of sugar in controlled conditions.
  - b. Organisms obtain oxygen from their environment in a variety of ways.
3. Food products and gases must be circulated to all cells throughout an organism (circulation).
  - a. Cells receive nourishment and eliminate waste through the process of diffusion.
  - b. More complex organisms show need for a more specialized circulatory system.
4. Organisms eliminate wastes to their environment (egestion and excretion).
5. *Growth* of an organism may result in change in structure or proportion, or an increase in size.
6. Living things react to their internal and external environment (sensitivity).
  - a. Different species may have different ways of receiving and responding to stimuli.
  - b. Living things differ in their response to the environment (adaptation).
7. To ensure survival of the species, living organisms must *reproduce*.
  - a. Some organisms reproduce sexually, some asexually, and some by both means.
  - b. An offspring inherits certain characteristics from its parents.
  - c. There are many variations within a population.
  - d. Living things have developed a variety of structural and behavioral adaptations to ensure reproduction.

7.4 All living things interact with and are interdependent with each other and their environment.

1. The biosphere is the region in which life on our planet is possible.
2. Eco-systems are units in the biosphere in which living and non-living things interact.
3. Plants and animals living and interacting in any eco-system are known as a community.
4. The members of each community show adaptations which are necessary for survival in the community.
  - a. Some organisms are specific to certain communities (distribution).
  - b. Some organisms may exist in more than one community (tolerance).
5. An organism is the product of both heredity and environment.
6. The environment and the distribution of organisms are in a state of continual change.
  - a. Nature constantly re-cycles materials.
  - b. Changes may take place over an extended period of time.
7. Man's influence on the environment can be directed constructively.
  - a. Man's influence may increase the rate of change with beneficial or harmful results to the environment.
  - b. Man commands the use of a great supply of energy to change the environment to his liking.
  - c. Man's production and use of energy causes pollution.
  - d. The preservation of man's biological resources depends on an awareness and the positive action of each individual.

## GRADE 7 LIFE SCIENCE PRINT RESOURCES

### Prescribed References

Carter, J. L. et al, *Life Science: A problem solving approach*.  
Scarborough: Ginn and Company, 1977

This text is aimed at developing both a basic understanding of the concepts of life science and the processes of scientific investigation. The laboratory investigations form an integral part of the topics that are studied. The student investigations are clearly outlined and easy to follow.

The text follows the program quite closely and the teacher's guide includes many good ideas and useful techniques and additional resources. The text has been screened by the Metric Commission and uses SI units.

Smallwood, W. L., *Challenges to Science: Life Science*.  
Scarborough: McGraw-Hill, 1976

This text follows the course outline very closely and includes many sections that are useful to students such as periodic review sections and the laboratory activities. A deliberate effort has been made to emphasize environmental concerns. The emphasis on the acquisition of knowledge make this text most suitable for average and above average students.

### Additional Textual Resources:

These are materials that are available in the market place but for one reason or another have not been recommended as prescribed references.

Educational Research Council of America, *You and the Environment: An Investigative Approach*. Markham: Houghton Mifflin, Canada, 1976.

The E.R.C. program has an exceptionally stimulating approach to the teaching of environmental studies. The text is well printed and although non-SI it has a lot to recommend it as a secondary resource.

Fabiano, E. R. and E. S. Liberson, *Life: Activities and Explorations*. Markham: Houghton-Mifflin, Canada, 1975.

For the less motivated student relatively weak in verbal mathematical or scientific skills. The concepts developed are more appropriate for the grade 10 program but may be of some use to teachers as an "Idea" book. Non-SI and American in orientation.

Heimler, C., *Focus on Life Science*.  
Agincourt: Charles E. Merrill, 1977.

An authoritative approach to the presentation of the concepts related to introductory biology. For the above average student who needs challenges and a greater depth of explanation.

Interaction Science Curriculum Project, *Interaction of Man and the Biosphere, second edition*. Agincourt: Gage and Co., 1974.

A highly activity-centered approach to teaching science calling for a lot of teacher-student interaction with materials and organisms. A source of many fine student activities.

Stone, A. H. and L. R. Sherman, *Spaceship Earth: Life Science*. Markham: Houghton Mifflin Canada, 1975.

A colorful, well-written program that emphasizes the inter-relationships among living things. The student experiments are simple and are an integral part of the program. It offers an alternative organizational plan that teachers might find useful.

Thurber, W. A. et al, *Exploring Life Science*.  
Toronto: Allyn and Bacon, 1975.

A book that incorporates many student activities in the development of the life science program. It poses a series of questions that a student should answer in exploring the topics covered by the program. It is non SI but is part of a program that is approved in many parts of Canada.

Wooley, I, et al, *Ryerson Science in Action*.  
Scarborough: McGraw-Hill, 1969-73.

A series of nine paperbacks designed for grades 4-7 that focusses on teaching science in the out-of-doors. An excellent resource for teachers.(Canadian but non SI).



Vance, F. R., et al, *Wildflowers Across the Prairies*.  
Saskatoon: Western Producer Prairie Books, 1977

Color photographs and descriptions of some 270 species of  
flowering plants of the northern great plains of North America.  
A most useful guide to wildflowers in the prairie region of Alberta.

#### TEACHER REFERENCES

Anderson, H. O. and P. G. Koutnik, *Toward More Effective Science  
Instruction in Secondary Education*. Don Mills:  
Collier-Macmillan, 1972

Norholt, E. et al, *Teaching High School Science: A Sourcebook for  
the Biological Science*. Don Mills: Longman Canada, 1958

Troyer, D. L. et al, *Sourcebook for Biological Sciences*.  
Don Mills: Collier-Macmillan, 1972

Romey, W. D., *Inquiry Techniques for Teaching Science*.  
Toronto: Prentice Hall, 1968

Biology Keys, School Book Branch, Alberta Education.  
Key to Alberta Amphibia  
Key to the Aquatic Mollusks  
Key to the Bryophytes  
Key to the Families of Alberta Fishes  
Key to the Mammals of Alberta  
Key to the Principal Groups of Alberta Insects  
Key to the Tree-Dwelling Lichens

Zim, et al, *Golden Nature Guides*.  
Don Mills: Fitzhenry and Whiteside, (Golden Press).

Salt, W. R. & A. L. Wilk, *Birds of Alberta*.  
Edmonton: Hurtig, 1976

Cormack, R. G. H., *Wild Flowers of Alberta*.  
Edmonton: Hurtig, 1977





# **EARTH SCIENCE**



## Grade Eight

### Prescribed References

Heller, R. L. et al, *Challenges to Science: Earth Science*.  
Scarborough: McGraw-Hill, 1976

Jackson, J. H. and E. D. Evans, *Spaceship Earth: Earth Science*.  
Don Mills: Houghton-Mifflin, 1976.

Objectives: After participating in the activities and completing the assignments associated with this course, the student should be able to:

- 8.1 Demonstrate a knowledge of and be able to discuss the identified major concepts and their associated subconcepts within the context of a study of the earth. These major concepts are:
  - 8.1.1 A perspective of the position and motion of the Earth in space is gained by celestial observations and measurements.
  - 8.1.2 Various theories attempt to explain the origin of the solar system and the universe.
  - 8.1.3 Matter everywhere in the universe seems to be composed of the same elements that are found in the Earth.
  - 8.1.4 The Sun is a typical star.
  - 8.1.5 The surface of the Earth and its inhabitants are surrounded by an atmosphere of air.
  - 8.1.6 Local conditions in the atmosphere are referred to as weather.
  - 8.1.7 Weather conditions as recorded over a long period of time define the climate of a region.
  - 8.1.8 Weather modification has occurred through man's activities.
  - 8.1.9 Water is an important part of the Earth's surface.
  - 8.1.10 The crust of the Earth is constantly being changed.
  - 8.1.11 The crust of the Earth is formed of rocks.
  - 8.1.12 Evidence for determining the past history of the Earth comes from a study of the crust.

- 8.2 Demonstrate increasing competence in the investigative skills associated with science:
- Observing with all of the senses
  - Manipulating technical instruments
  - Collecting reliable data
  - Manipulating the data to identify any patterns
  - Interpreting data, making inferences leading to hypotheses, and predicting future behavior.
- 8.3 Participate in a study of some local phenomenon such as the weather patterns over a period of time, collect the data and relate these to the regional patterns and the long-term climatic conditions.
- 8.4 Recognize and be able to cite the contributions to modern theories of such scientists as Galileo, Kepler, Hutton and Wegener.
- 8.5 Examine topics of current scientific interest in an objective and open-minded manner.

#### CONCEPTS TO BE DEVELOPED

- |   |   |
|---|---|
| 8.1 A perspective of the position and motion of the Earth in space is gained by celestial observation and measurements. | <ol style="list-style-type: none"><li>1. Through history man has searched for a systematic way of orienting himself and explaining his observations.</li><li>2. The motions of the Earth with respect to its neighbors have a profound effect on man.</li><li>3. The tools and technology used by Earth-Space scientists vary tremendously. Earth-Space scientists use information from their observations to develop explanations of the universe.</li></ol> |
| 8.2 Various theories attempt to explain the origin of the solar system and the universe.                                | <ol style="list-style-type: none"><li>1. Man's religions offer an explanation of the Earth's origins.</li><li>2. Science views the origins in terms of observable processes.<ol style="list-style-type: none"><li>a. Big Bang Theory is widely held as a possible explanation.</li></ol></li></ol>  |



- b. Many others hold that the Steady-State Theory is more acceptable.
- c. Solar system origins can be explained in other ways.

8.3 Matter everywhere in the universe seems to be composed of the same elements that are found on the Earth.

1. Our knowledge of the universe comes from an analysis of its radiation.
  - a. Spectroscopic studies of the radiation aid in gaining knowledge about stars and planets.
  - b. Radiation is studied with optical and radio telescopes.
2. Matter is clustered more densely in some parts of the universe.
  - a. The largest local clusters of matter are galaxies.
    - galaxies are accumulations of many stellar bodies.
  - b. Stars and other celestial bodies can be classified and grouped.
3. Matter in the universe appears to be moving at tremendous velocities.
  - a. Interstellar distances are measured in light years, and astronomical units.
  - b. Observations of celestial positions are made over a period of many years to determine motions in the universe.

8.4 The Sun is a typical star.

1. Much of what we surmise about the stars comes from our observations of the Sun.
  - a. Radiation from the Sun can be used to investigate its structure, motions, history and processes.
  - b. Solar radiation is both beneficial and harmful to life on its planets.
  - c. Solar gravity and planetary inertia maintain a system of planets in orbit.
    - Planetary motion is predictable.
    - The members of this solar system differ in their physical characteristics and dynamic properties:
      - several planets have satellites of their own,
      - the moon provides an opportunity to study an extra-terrestrial body;
    - Exploration of space has generated new knowledge, new technologies, and new problems.

2. Most of the Earth's energy comes from the Sun.
    - The radiation affects the atmosphere, the oceans and the land masses.
- 8.5 The surface of the Earth and its inhabitants are surrounded by an atmosphere of air.
1. Air is matter.
    - a. Air is a mixture of gases.
    - b. Air has weight and exerts pressure which can be measured.
  2. The atmosphere is heated by the Sun's energy which is absorbed by the Earth.
    - a. Radiant energy from the Sun is transformed into sensible and latent heat. Much of the incoming heat is absorbed by the Earth and its oceans.
    - b. Heat absorption by the Earth varies.
      - Light colored areas reflect more heat than dark areas.
      - Oceanic areas reflect more heat than continental areas.
      - The altitude of the Sun above the horizon affects the heat absorbed.
    - c. Absorbed heat is distributed by a number of mechanisms.
      - Radiation is a means by which a warm body loses heat
      - Convection currents distribute heat quickly and efficiently
      - The distribution of heat is also achieved by conduction.
  3. The air of the atmosphere is in constant motion due to unequal heating and the rotation of the Earth.
    - a. There is a pattern to the planetary winds with several clearly definable zones.
    - b. Local winds are affected by land forms and bodies of water.
  4. Water vapor is an important constituent of air.
    - a. Water vapor enters the atmosphere by evaporation.
    - b. Water vapor eventually condenses as the air is cooled and becomes saturated.

- Clouds and fog are condensed moisture suspended in the air
- Precipitation is the result of moisture droplets becoming too large to remain in suspension.

8.6 Local conditions in the atmosphere are referred to as weather.

1. Weather reports give information about local and global atmospheric conditions.
  - a. The information is gathered by instruments at weather stations and by weather satellites.
  - b. The information given includes reports of air pressure, air temperature, relative humidity, wind direction and speed, cloud cover and precipitation.
  - c. The weather map is a record of the information gathered and is used to predict future weather.
2. An air mass is a large body of air with similar temperature and humidity at all levels.
  - a. Fronts form at the boundary between different air masses.
    - Fronts can be classified
    - Changes in weather are often associated with fronts
    - Violent storms are often associated with fronts.
  - b. High pressure areas often serve to define the extent of air masses.
  - c. Low pressure areas usually form in association with fronts.

8.7 Weather conditions as recorded over a long period of time define the climate of a region.

1. Weather statistics over a period of time can be used to compare one region with another.
  - Latitude, altitude, and position with respect to certain land forms and bodies of water determine the climate in a region.
2. Climate determines much of man's activities, housing, dress and diet.

8.8 Weather modification has occurred through man's activities.

1. Atmospheric pollution has become a major issue.

2. Rain-making and hail suppression are active research topics.
  3. Fog and frost control has economic value.
- 8.9 Water is an important part of the Earth's surface.
1. The water cycle is the continuous movement of moisture from ocean to land and return.
  2. The oceans form a large portion of the Earth's surface.
    - a. Sea water contains many minerals in solution.
    - b. There is a wide diversity of living organisms in the oceans.
      - The ocean's food supply may be very important to man's survival.
    - c. The ocean floor has topography similar to that on the continents, with several important differences.
      - The continental margins are very important features both politically and economically.
    - d. The circulation patterns of the ocean's water are the result of forces similar to those affecting the atmosphere.
      - Currents in ocean water are initiated by differences in density, salinity, and by the prevailing winds.
      - Movement of sea water tends to distribute heat.
    - e. Wave action within bodies of water is an important force in the modification of the shore line.
    - f. Tides are caused by the gravitational attraction between the Earth, Moon and Sun.
- 8.10 The crust of the Earth is constantly being changed.
1. Erosion is the process of wearing down of the land forms.
    - a. Precipitation falls on the land areas and runs off to the sea.
      - Running water on the land surface tends to reduce the relief;

- The rate of erosion depends upon the amount of run off, the gradient of the slope, the type of rock, and the ground cover;
  - Water run-off forms brooks, which form streams, which form river systems;
  - Sediments may be redeposited many times on their journey to the sea;
  - Soil is formed from the breakdown of the rock material;
  - Water that does not run off is held as ground water near the surface. In cold regions the ground water is held in perma-frost;
  - In cold climates precipitation builds up into glaciers; glaciers move under the influence of gravity and in doing so change the land surface. Surface features serve as evidence of past glaciation.
  - b. Air movements carry materials from one place to another.
    - Windblown material is deposited in characteristic surface features.
    - Soil removal by winds may have serious economic effects.
2. Landforms are being built up by movements within the crust.
- a. Forces within the Earth cause deformation of surface features.
    - Earthquakes are the result of movements of masses of rock.
    - Volcanism is associated with faulting in the crust.
    - Faulting and folding are the result of large forces in the crust.
  - b. Forces acting on the crust results from the nature of the structure of the Earth.
  - c. Theories have been advanced to explain how forces have acted on the crust to produce the present landforms.
    - Continental drift, plate tectonics and sea floor spreading are theories advanced to explain crustal deformation.

8.11 The crust of the Earth is formed of rocks.

1. Rocks can be categorized into three main groups.
  - a. Initially all rocks were formed by the cooling magma of the Earth.  
-Texture and mineral content of igneous rocks can be used for identification.
  - b. Erosion and/or deposition form sedimentary rocks.  
-Grain size and/or mineral content of sedimentary rocks can be used for identification.
  - c. Metamorphic rocks are reconstituted sedimentary and igneous rocks.  
-Metamorphic rocks are classified on the basis of their mineral content and structure.
2. Materials from the crust have had an important influence on the history of man.
  - a. Man has mined the Earth for materials since prehistoric times. The mining of certain minerals is economically very important in Canada.
  - b. Fossil fuels and their products are important in the economy of Alberta.
  - c. Other rocks and minerals are of economic importance to Albertans.
  - d. Crustal materials are limited and exploitation must be managed for maximum benefit.

8.12 Evidence for determining the past history of the Earth comes from a study of the crust.

1. Age determinations can be estimated on the basis of rates of changes of crustal materials.
  - a. Sediments have been laid down throughout the life of the Earth.
  - b. Radioactive elements decay at a measurable rate.
2. Fossil evidence can be used to relate past events in the history of the Earth from one place to another.
  - a. There are different kinds of fossil evidence; remains, casts, molds, and replacement fossils.
  - b. Fossil evidence is used in oil and gas exploration.



3. Earth history can be divided into periods of time on the basis of the type of fossil evidence.
  - Through geologic time life has become more complex and diversified.



## GRADE 8 EARTH SCIENCE PRINT RESOURCES

### Prescribed References

Heller, R. L. et al, *Challenges to Science: Earth Science*.  
Scarborough: McGraw-Hill, 1976

A stimulating text written in a colloquial style which will appeal to many students. Most topics normally studied in Grade 8 are presented at a level involving a good deal of physics and chemistry. Student activities, though rather limited, do relate directly to content. The selection of color photos and diagrams appears adequate, but may have to be supplemented to relate more specifically to Alberta. This text has been screened by the Metric Commission staff and uses SI units throughout.

Jackson, J. H. and E. D. Evans, *Spaceship Earth: Earth Science*.  
Markham: Houghton-Mifflin, 1976

This book offers a unique and appealing approach to the study of Earth Science, (see chapter introductions and "Skullduggery" section at chapter end) yet presents an excellent blend of "discovery approach" along with concept development. It also offers a balanced approach to the theory of evolution and the Biblical explanation. Considerable emphasis is placed on the topic of space with little emphasis on glaciation. The reading level and the many fine illustrations make it a very useful text. It does not however use SI units consistently and some imperial units appear in the descriptions.

### Additional Textual Resources

These are materials that are available in the market place but for one reason or another have not been recommended as prescribed references.

Harris, M. F., et al, *Investigating the Earth, Revised Edition*.  
Markham: Houghton Mifflin, 1973

Presents Earth Science in a unified manner utilizing a concept development approach. Many and unique investigations together with excellent illustrations all emphasize the inquiry orientation of the book. Written for the able or above-average student. Good as a teacher reference and as an alternate student reference.

Bishop, M., et al, *Focus on Earth Science* - 2nd edition.  
Agincourt: Charles E. Merrill, 1976

Fairly detailed coverage of the Earth, its rocks and minerals, its crust, and its atmosphere. Well illustrated with end-of-chapter activities serving as good review. Activities or laboratory work are supplemental rather than essential to the content presented. Reading level likely above that of the average Grade 8 student. Useful as a teacher and/or student general reference.

Hibbs, A. R. and A. F. Eiss, *The Earth-Space Sciences*.  
Toronto: Doubleday Canada, 1971

A solid comprehensive book that presents a broad, integrated perspective of the universe, the solar system, and the Earth. The controlled vocabulary used in the text all but ensures that the student learns the necessary terms as they first appear in their proper context. The process dimension is introduced in practically every lesson. The style is readable and clear, and much thought has gone into the selection of the diagrams and photographs which amply illustrate the text. The book can be recommended for use as an alternative program that introduces students to Earth-Space science. It does not use SI units.

Interaction Science Curriculum Project, *Interaction of Earth and Time*. Agincourt: Gage and Company, 1974

This text uses activities, investigations and experiments to focus on Earth Science concepts and on science processes. Kits of laboratory supplies are recommended but most of the experiments can be performed with inexpensive materials. Many fine colored photographs and historical prints are included. Metric units are used but it has not been screened by the Metric Commission Staff. The higher than average reading level and complex laboratory instructions reduce the general usefulness of this text.

Ramsey, W. L. , et al, *Modern Earth Science*.  
Toronto: Holt Rinehart and Winston, 1973

The authors have produced a comprehensive set of materials that presents a view of the Earth and its content in a non-dogmatical way. The program has a high dependence on reading the text and a lot of the activities evolve from an interpretive type of action and tend to be very cognitive in character. The material covers a large number of topics to a considerable depth. The reading and conceptual level is a little high being aimed at a Grade 9 market. For example Kepler's laws are introduced on page 13 and Newton's Law of Gravitation on Page 15 in considerable detail. An excellent resource for the teacher! The rather poor use of metric units is somewhat distracting.

### TEACHER REFERENCES

In addition to the teacher's editions of the above titles, the following seem especially suited as resources:

Abell, G., *Exploration of the Universe*.  
Toronto: Holt, Rinehart & Winston, 1969

A.G.I., *Geology & Earth Sciences*. Sourcebook.  
Toronto: Holt, Rinehart & Winston, 1970

Beckway, G. W. and E. Young, *Investigations in Earth Science*,  
Ajax: Stark Scientific (Hubbard Press), 1968

Joseph, A., et al, *A Sourcebook for the Physical Sciences*,  
Don Mills: Longman Canada, 1961

Longley, Richmond W., *The Climate of the Prairie Provinces*,  
Ottawa: Environment Canada, 1972

Nelson, S., *The Face of Time*,  
Calgary: Alberta Society of Petroleum Geologists

UNESCO, *Sourcebook for Science Teaching*.  
Ottawa: Information Canada 1962

Utgard, R. O., G. T. Ladd and H. O. Anderson, *Sourcebook for  
Earth Sciences and Astronomy*, Don Mills: Collier-Macmillan,  
1972

Zim, et al, *Golden Nature Guides*

-Fossils	-Geology
-Stars	-Landforms
-Rocks and Minerals	-Ecology
-Weather	

Don Mills: Fitzhenry & Whiteside (Golden Press).

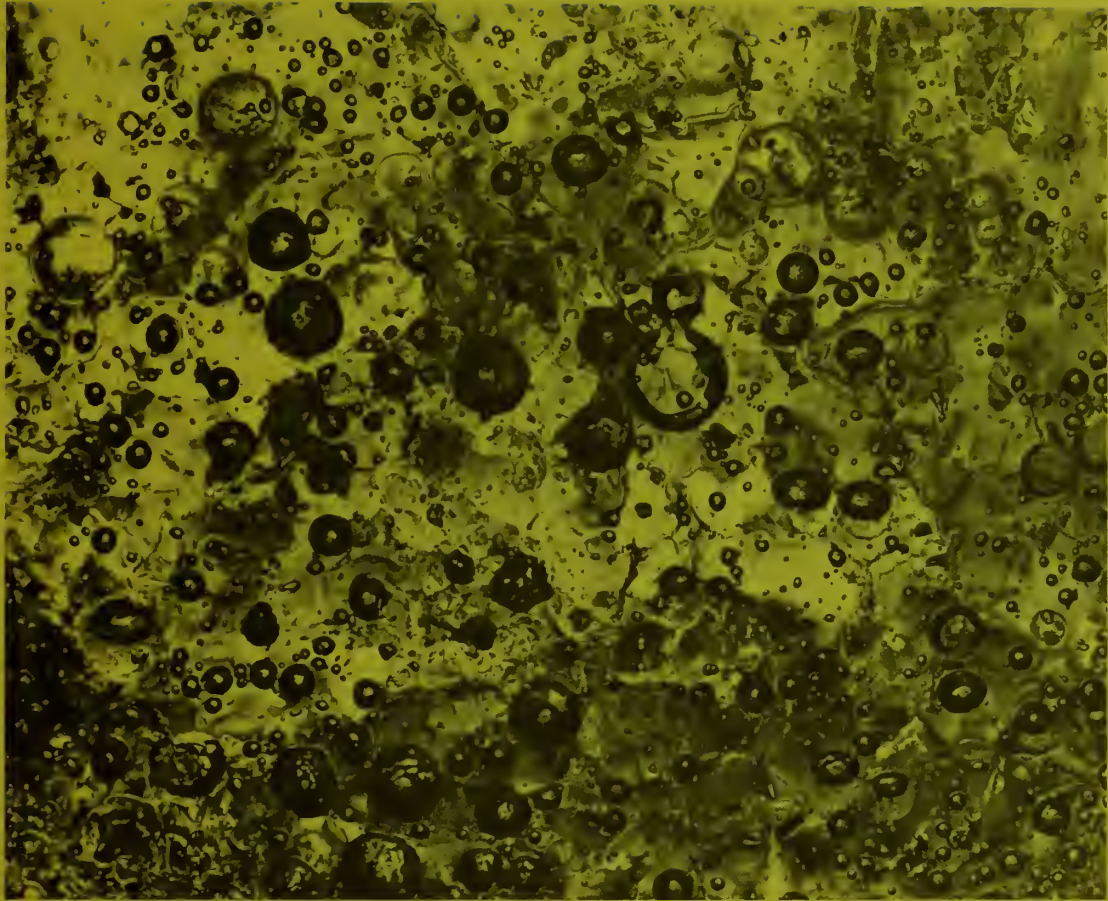
*Science and Creation*  
A Handbook for Teachers

Creation-Science Research  
Center, 2716 Madison Avenue  
San Diego, Calif.

List of Resource Materials  
for Earth Science Teachers  
in Canadian Schools

Canadian Geoscience Council  
c/o Queens University





# PHYSICAL SCIENCE





### Grade Nine

Bickel, C. L., et al, *Physical Science Investigations*.  
Don Mills: Houghton Mifflin, 1976

Carter, J. L., et al, *Physical Science: A Problem Solving Approach*. Scarborough: Ginn and Co., 1977

Heath, R. W. and R. R. McNaughton, *Physical Science: Interaction of Matter and Energy*. Toronto: D. C. Heath, 1976

Townsend, R. D. and P. DeH. Hurd, *Energy, Matter and Change*.  
Agincourt: Gage and Co. 1973

Objectives: After participating in the activities and completing the assignments associated with this course, the student should be able to:

- 9.1 Demonstrate a knowledge of and be able to discuss the identified major concepts and their associated subconcepts within the context of a study of physical science. These major concepts are:
  - 9.1.1 Matter occupies space and has mass.
  - 9.1.2 The forms and behavior of matter can be explained by the kinetic molecular Theory.
  - 9.1.3 The many forms of energy can be transferred from place to place or converted from one form to another, but in each case, the total amount of energy remains constant.
  - 9.1.4 Matter and Energy are related and are interchangeable.
  - 9.1.5 Energy is responsible for bringing about physical and/or chemical changes in the forms and behavior of matter.
- 9.2 Demonstrate proficiency in the scientific investigative skills of:
  - Problem identification
  - Outlining procedures and safe work habits
  - Organizing observations and data
  - Recording results
  - Making inferences which relate to hypotheses
  - Predicting future behaviors
- 9.3 Identify and discuss the development of a major scientific concept such as the kinetic molecular theory as it was explained by Galileo, Bacon, Thompson, Davy and Maxwell.

- 9.4 Participate in the routine management of the laboratory program by being responsible for the preparation of materials and equipment prior to and following laboratory periods.
- 9.5 Investigate scientific factors involved with a technological topic such as the development of alternative sources of energy.

#### CONCEPTS TO BE DEVELOPED

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- 9.1 Matter occupies space and has mass.

- 1. Fundamental to the process of science is the establishment of standards for making measurements.
  - a. The development of standard units and systems of measurement has taken place slowly.
  - b. Good measurement techniques are necessary in order to obtain meaningful data.
  - c. All measurements are approximate.
  - d. Relationships existing between measurement data are often more clearly defined and understanding clarified, by graphing techniques.
- 2. Matter can be measured by determining its linear dimensions, its surface area and its volume.
  - a. Area is the number of square units of surface.
  - b. Volume is the space occupied by matter.
  - c. Volume of irregularly shaped solids may be found indirectly by liquid displacement.
- 3. Matter can be measured in terms of its mass and weight.
  - a. Mass is a measure of the quantity of matter in an object.
  - b. Weight of an object is a measure of the force of gravity acting on the object.

4. Density (average density) is a measure of the mass per unit volume of matter.
  - a. Density is a characteristic property of any given sample of matter and is, therefore, useful for identification purposes.
  - b. Molecular arrangement influences density.
  - c. As the volume of a substance changes in response to temperature variation, the density changes.
  - d. The influence of temperature change on density is generally less for a solid than for a liquid, and less for a liquid than for a gas.
5. Pressure is a measure of force acting on a unit area.
  - a. Solids exert pressure on a surface.
  - b. Fluid pressure varies directly with depth.
  - c. At any point within a fluid, force and pressure are equal in all directions.
  - d. Objects placed in fluids are subject to an upward buoyant force.
  - e. In moving fluids, pressure decreases as velocity increases.
6. Inertia is a fundamental property of matter.

-Matter has a natural tendency to continue in whatever state of motion or rest it is in, at any given instant.

9.2 The forms and behavior of matter can be explained by the Kinetic Molecular Theory

1. Matter is composed of tiny particles.
  - a. A molecule is the smallest particle of matter that has the properties of a larger amount of that size.
  - b. Molecules vary in size.
  - c. Spaces exist between the molecules of matter.
  - d. Molecular composition determines the chemical properties of matter.
  - e. Physical properties of matter are determined by inter-molecular distances and forces.

2. Molecules are in a state of constant motion.
  - a. Brownian movement provides indirect evidence of molecular motion.
  - b. Motion may be vibrational about a fixed position (solids).
  - c. Molecules may be able to slide or move over one another in random directions (liquids).
  - d. Molecules may have considerable freedom of movement in random directions (gases).
  - e. The greater the freedom and rate of movement of molecules of the same kind, the higher their energy content.
  
3. Heat and temperature are related.
  - a. Heat refers to the total energy content of a substance due to molecular motion.
  - b. Temperature is a measure of the average kinetic energy content of the molecules of a substance.
  - c. Temperatures may be measured indirectly by utilizing the response of matter to changes in temperature.
    - An arbitrarily chosen standard is necessary in the construction of most temperature scales.
    - Several temperatures scales have been devised:
      - Celsius
      - Kelvin
      - Others
  - d. Heat is measured indirectly by the effects it produces.
    - Heat is measured by observing temperature changes of a known mass of water at a known initial temperature.
    - Heat is measured in joules.
  - e. Different substances absorb or release different amounts of heat, even though they have similar masses and undergo similar temperature changes.
    - The heat capacity of water is greater than that of most other substances.
    - Substances having high heat capacities are good coolants.

- f. When a body at higher temperature is in contact with a body at a lower temperature, heat flows from the first to the second body.  
-Heat is conserved in that the amount of heat lost by one substance is equal to the amount of heat gained by the other.
- 4. Matter exists in different states.
  - a. Matter can exist in solid, liquid or gas form.  
-Each state is characterized by definite general properties.
  - b. The addition or removal of heat causes matter to change state.
  - c. As any given pure substance changes state, its properties change, its composition does not.
  - d. Temperature remains constant during a change of state.
  - e. The amount of heat required to change a given quantity of matter from solid to liquid, or from liquid to gas, is called latent heat of fusion and latent heat of vaporization, respectively.
- 5. A relationship exists between molecular motion and the volume occupied by matter.
  - a. With few exceptions the volume of a solid increases as molecular vibrational motion increases.
  - b. With the exception of water at temperatures below  $4^{\circ}\text{C}$ , liquids increase in volume as molecular motion increases.
  - c. All gases, at constant pressure, expand uniformly as molecular motion increases.
- 6. Molecular movement is the basis for diffusion.
  - a. Diffusion is the penetration of one type of molecule into matter consisting of a second type of molecule.
  - b. Diffusion is slow in solids due to limited molecular motion and their closely packed orderly arrangement.



- c. Diffusion takes place more readily in liquids and gases.
  - d. Rate of diffusion depends on the temperature of the substances.
  - e. Rate of diffusion depends on the size of the molecules involved.
  - f. Dissolving is a form of diffusion.
  - g. Solutions are formed when molecules of one substance spread out evenly throughout another substance.
    - No boundaries between components of a solution can be observed.
7. Pressure in gases results from molecular motion.
- a. Gas pressure is due to molecular bombardment of a surface.
  - b. Pressure depends upon the number of molecules present and their average speed.
  - c. Compression of gases results in increased molecular motion and thus increased temperature.
  - d. Expansion of gases results in reduced molecular motion and thus reduction of temperature.
8. Molecular motion results in evaporation.
- a. Evaporation involves a change in state from a liquid to a gas.
  - b. Evaporation occurs as faster moving molecules near the surface escape.
  - c. Evaporation produces a cooling effect.
  - d. Different liquids evaporate at different rates.
  - e. Rate of evaporation of a given liquid depends on:
    - Temperature of the liquid
    - Vapor content of the air above
    - Movement of air across the liquid surface
    - Surface area of the liquid that is in contact with the air.



9. Forces of attraction between molecules and characteristics of the molecules of a substance account for many properties of matter.
  - a. Cohesion results from the forces of attraction existing between molecules of the same kind.
    - Cohesive forces are greatest in solids, weaker in liquids, and negligible in gases.
    - Tensile strength is a measure of cohesion between adjacent molecules.
    - Ductility, malleability and elasticity depend on cohesive forces.
    - Surface tension of liquids depends on cohesive forces.
  - b. Adhesion is the force with which unlike molecules attract each other.
  - c. Shape of liquid surfaces depend on cohesion and adhesion.
  - d. Capillarity depends on both adhesion and surface tension.

9.3 The many forms of energy can be transferred from place to place or converted from one form to another, but in each case, the total amount of energy remains constant.

1. Energy is the ability or capacity to do work or cause motion.
  - Work encompasses factors of force, distance, movement and direction.
  - Work is accomplished only when the applied force causes an object to move in the same direction as the force.
  - Units of measurement have been devised which quantitatively express force, distance and work.
  - The rate at which work is done is defined as power.
2. Energy can be transferred from one place to another.
  - a. Work represents a transfer of energy and/or heat.
  - b. Machines transfer energy from place to place in order to do work advantageous to man.
    - Considering inclined planes, simple pulleys and pulley systems, and simple levers, machines are devices man uses to multiply force, to change the direction of a force, to gain speed, or to gain distance.

- c. The transfer and conversion of energy underlies conduction, convection, radiation.
- d. The transfer and conversion of energy underlies light, sound and electricity.

3. Energy may be described as either kinetic or potential energy.

- a. Energy is present in the universe in several forms:
  - electrical energy
  - chemical energy
  - mechanical energy
  - heat energy
  - light energy
  - nuclear energy
  - gravitational energy
  - magnetic energy
- b. One form of energy may be changed into another.

4. In all energy changes or transfers, the total amount of energy remains constant (Law of Conservation of Energy).

9.4 Matter and energy are related and interchangeable.

1. Theories and/or models have been developed to assist in understanding atoms.

- a. All matter is made up of atoms.
- b. The atomic model has an internal structure consisting of protons and neutrons forming a central core or nucleus, and an outer structure of electrons.
- c. The various kinds of atoms are called elements.

2. A relationship exists between atoms and molecules.

-Atoms can exist individually or in combination with other atoms of the same or different elements, and therefore, are the building blocks of molecules.

3. A relationship exists among elements, compounds and mixtures.

4. Matter and energy are interrelated. The total amount of energy and matter in the universe remains constant.
  - a. Matter is split apart to release energy in fission reactions.
  - b. Matter is combined to release energy in fusion reactions.

9.5 Energy is responsible for bringing about physical and/or chemical changes in the forms and behavior of matter.

1. There is a difference between physical and chemical changes.
  - a. In a physical change, one or more of the properties of a substance are altered but not its composition or identity.
    - A change of state represents one of the most common physical changes.
    - Changes in molecular motion and inter-molecular distances and forces of attraction account for physical changes.
  - b. In a chemical change, atoms are rearranged resulting in new substances with new properties.
    - Most chemical changes require a great deal more energy than do physical changes.
  - c. Some changes are reversible, some occur in cycles, some are irreversible.
2. There are several kinds of chemical changes or reactions.
3. Chemical reactions are usually accompanied by energy changes.
4. Rate of chemical reaction may be affected by temperature, concentration, surface area and catalysts.

## GRADE 9 PHYSICAL SCIENCE PRINT RESOURCES

### Prescribed References

Bickel, C. L., et al, *Physical Science Investigations*.  
Markham: Houghton Mifflin Canada, 1976

A straight-forward presentation of physical science topics that develops the concepts by having students participate in many activities. It follows the program reasonably well and uses metric units although it is not SI. There are some potentially dangerous activities with mercury on pp 142 and 211-215 that should be monitored closely.

Carter, J. L., et al, *Physical Science: A Problem Solving Approach*. Scarborough: Ginn and Co., 1977

A directed-inquiry approach characterizes this text. Geared to the needs of the average student, the text incorporates clearly outlined experiments and exercises that focus attention on the main purpose of the chapter. The teacher's guide includes suggestions for teaching, for managing the program and a set of transparency masters. It is SI and approved by the Metric Commission.

Heath, R. W., and R. R. Macnaughton, *Physical Science: Interaction of Matter and Energy*. Toronto: D. C. Heath, 1976

An activity-centered approach to the teaching of physical science that follows the program quite well. The kinetic-molecular theory provides the theme of the book and the science processes structure the laboratory activities. The teacher's guide provides assistance in the laboratory activities highlighting the cautions and the salient points that are to be made in each activity. It is Canadian and SI. There are some potentially hazardous experiments with carbon disulphide (p.67), molten sulphur (pp.88-89) that should only be done as demonstrations.

Townsend, R. D., and P. DeM. Hurd, *Energy, Matter and Change*. Agincourt: Gage and Co., 1973

A clearly written, colorful text with many demonstrations. There is much more material than can be used and some choice must be made to complete the program. The reading level is a little high and this text is more for the above average student. The accompanying laboratory manual is needed to guide the student through the lab activities. (American and non-SI).

#### Additional Textual Resources:

These are materials that are available in the market place but for one reason or another are not recommended as prescribed references.

Hill, F. F. and P. B. Barcaski, *Spaceship Earth: Physical Science*. Markham: Houghton Mifflin Canada, 1977.

Physical science is related to everyday experiences and concerns of average grade nine students. It is written in a simple straightforward style that is very useful in the classroom. The content follows the outline rather poorly, and unfortunately imperial units are freely mixed with metric throughout the text.

Interaction Science Curriculum Project, *Interaction of Matter and Energy, Second Edition*. Agincourt: Gage Publishing, 1974

A highly activity-centered approach to the teaching of physical science. The teacher's guide is an invaluable source of ideas and organizational assistance for a student-centered laboratory program.

#### Teacher References

In addition to the teacher's guides to the above, the following titles seem suited as resources:

Anderson, H. O. and P. G. Koutnik, *Toward More Effective Science Instruction in Secondary Education*.  
Don Mills: Collier-Macmillan, 1972

Joseph, A., et al, *A Sourcebook for the Physical Sciences*.  
Don Mills: Longman Canada, 1961

UNESCO, *Unesco Source Book for Science Teaching, revised and enlarged edition*. Ottawa: Information Canada, 1962





## SUGGESTIONS FOR IMPLEMENTING THE SCIENCE PROGRAM

### A. AN APPROACH TO THE TEACHING OF JUNIOR HIGH SCHOOL SCIENCE.

#### 1. *Nature of Science*

Today's science programs emphasize inductive modes of inquiry. In the past, much science teaching in the Junior High School has treated science as dogma. To a large degree, the difference stems from one's definition and view of science. In oversimplified terms, when science is regarded as an accumulation of facts, it is defensible to design curricula with the goal of creating the most efficient scheme for teaching these facts. On the other hand, when science is regarded as an active, human process for acquiring knowledge, curricula must be designed to bring the learner into a direct encounter with this process. The substance of inductive inquiry is data; data and concepts are essential ingredients of inquiry. However, they are not the totality of science; processes of inquiry must be included and balanced against content.

In today's Junior High Science programs inquiry involves human activity in search of meaning. It involves both the student and the teacher in an active process. Recitation followed by student feedback would seem to be anti-thetical to the process of inquiry. Science is a body of knowledge and a process of inquiry.

Students should be given opportunities to recognize, understand, and evaluate the social and environmental consequences of scientific discoveries. The humanistic view of science should receive substantial emphasis. In order for students to understand the significance of science in the progress of civilization, they should be challenged to bring scientific considerations into social issues.



## 2. *Process Skills*

Strong recognition must be given to process. However, process skills should not be developed simply for their own sake. Rather, process skills, including observing, interpreting, and hypothesizing should be developed as an integral part of programs and used as they are required by the student to gain and process data and information to develop concepts.

## 3. *Concept Formation*

It is important for the teacher to remember that a concept is a gradually-developing and continuous verbal and mental image, which is unique to each student. Concepts are not taught directly by the teacher, but are primarily the result of mental and physical activity on the part of the learner. Experiences with real things should be presented within a conceptual framework.

## B. USE OF TEXTBOOKS

All too often a textbook has been accepted in many classrooms as the program of studies. Experience has shown that the use of a single text has resulted in problems when teachers attempt to meet the range of individual abilities. One must consider both the strengths and limitations of a textbook and exercise discretion in its use. The use of a variety of texts helps to provide alternate methods and approaches to accommodate ranges of performance and interest. No text, manual, or single aid will provide a creative and appealing approach to instruction. Children differ and communities are varied, so that the creative ability and background of children demand variation in instructional patterns.



### C. STUDENT EVALUATION

The nature of the Junior High Science course, i.e. an activity-centered science course geared to providing *successful* student experiences calls for different kinds of teaching and evaluating. Too often we assume that students have skills and are able to use scientific processes. These skills and processes must be taught, practiced, and evaluated. This evaluation should be continuous with maximum student participation.

Evaluation should also be concerned with the attainment of conceptual knowledge but there should also be a large component concerned with the attainment of the affective goals. That is to say we must attempt to measure not only the pupil's growth in the knowledge dimension but also in the attitudinal dimension.

### D. SAFETY AND MAINTENANCE OF THE SCIENCE LABORATORY

1. Teachers should be aware of potential hazards incumbent in any experiment or demonstration which is to be incorporated into the science program.
2. Students should be made aware of hazards in doing any experiment and should be made to understand and follow the directions.
3. Chemicals should be stored in a safe, secure, and orderly manner.
4. All laboratory activities should be supervised.
5. Students should be taught how to use and care for laboratory equipment.
6. All apparatus and equipment should be in good repair.
7. Safety equipment (fire extinguishers, asbestos blankets, eye washers, first aid kits, etc.) should be readily accessible. Students should be instructed in the proper use of this equipment.
8. Teachers should be conversant with the policies and statements adopted by their employing board. In the absence of such statements teachers should be aware of the specific hazards that students face in the science program and have taken suitable precautions against such hazards.
9. All accidents should be reported to the principal without delay.

## SUGGESTIONS REGARDING A FIELD STUDIES PROGRAM

Field tripping or outdoor education as a valuable contributing component to any total educational program in our Alberta schools is now recognized and accepted. Nevertheless schools or classes contemplating such activities must bear in mind certain responsibilities. This statement is presented here to alert teachers, principals administrators, and others so that all necessary steps may be taken to ensure success.



A good deal of literature, local and otherwise, now exists on this topic and those undertaking field tripping for the first time would be well advised to avail themselves of this information where possible. Adequate pre-planning is the key to a successful field trip whether it be



of short or long duration; whether it be taking students a few hundred yards or several hundred miles.

A field trip must be based on clearly defined objectives. Since field tripping requires an expenditure of a great deal of time and often money, the results to students should at all times justify the efforts necessary.

In setting objectives and in pre-planning the undertaking many important considerations have to be taken into account. Some of these relate to the age of the students, parents' consent, compliance with board policies, and adequate and responsible adult supervision. There are many others.

To fully cover the topic of field tripping or outdoor education is not the intent of this publication. The intent is to suggest that field tripping cannot be undertaken lightly and that careful planning must precede any such activity.

The following check list is included as a sample guide in suggesting the kinds of items which should receive attention.

#### \*CHECK LIST

(Not all-inclusive and only suggestive)

- ( ) 1. The objectives of the field trip have been clearly identified.
- ( ) 2. The field trip site has been visited and studied.
- ( ) 3. Field trip site entry has been cleared and booked.
- ( ) 4. Students who will participate have been identified.
- ( ) 5. An outline of student activities has been prepared.
- ( ) 6. Permission from the proper school authorities has been obtained. (School Board included).
- ( ) 7. Parental consent has been obtained in writing.
- ( ) 8. All financial commitments have been looked after.
- ( ) 9. All teachers whose classes may be affected have been properly consulted.

\*Adapted from *A Guide to Field Tripping*, Calgary Board of Education.

- ( ) 10. Any required student skills have been taught.
- ( ) 11. Proper and adequate transportation has been arranged.
- ( ) 12. A full schedule of times and events has been prepared including departure and arrival time.
- ( ) 13. Adequate and responsible adult supervising personnel have been assured.
- ( ) 14. First aid requirements have been met.
- ( ) 15. Proper clothing requirements have been established.
- ( ) 16. Guidelines for behavior have been established for all.
- ( ) 17. Proper and adequate food supply has been assured.
- ( ) 18. Duties and responsibilities of all supervisory personnel has been outlined.
- ( ) 19. Supplies and equipment for all have been identified and arranged for.
- ( ) 20. Safety precautions have been outlined.

#### FOLLOWING-UP A FIELD TRIP

It is generally accepted that follow-up activities are of equal importance to the in-the-field experience. Some follow-up activities might include reporting by various committees on the data collected, organization and review of ideas and materials gathered, bulletin board displays, demonstrations, worksheets, discussions and testing and identifying specimen materials obtained. Each student should have some responsibility in interpreting what he saw and explaining what it means.

#### EVALUATION

The teacher should attempt to determine the degree to which his other purposes for taking the field study were met. Evaluation might include completed questionnaires, student prepared booklets, and evidence that might be collected to support the general objectives of Junior High Science. Problems that arose should be noted for revision of plans for future trips. Some attempt should also be made to determine the usefulness of the resource site for future field studies.



## CONTROVERSIAL ISSUES

In August 1972, The Minister of Education announced a policy regarding controversial issues. This announcement was in response to representation having been made regarding the treatment in school programs of such matters as Canadian content, family life education, sex-stereotyping and special creation, to name a few. By way of interpretation the policy is to be treated as a whole. That is, no clause is to be applied in isolation of any other clause or clauses in the policy. The policy is intended to accomplish the following in the handling of issues such as those mentioned above.

- 1) Provincially it will:
  - a) guide the development and revision of Programs of Study, including the acquisition of support materials.
  - b) serve as the Department of Education position in cases in which the Department may be consulted regarding controversial issues.
- 2) Locally, the statement is to serve as a guide for the development of policy at system, district or school levels, according to local choice.

### Department of Education Policy

#### Re: Controversial Issues in the Classroom

- I. In principle, it is an objective of the Alberta educational system to develop students' capacities to think clearly, reason logically, examine all issues and reach sound judgements.
- II. The specific policy, based on this principle, is:
  1. Students in Alberta classrooms should not be ridiculed or embarrassed for positions which they hold on any issue, a requirement which calls for sensitivity on the part of teachers, students and other participants in dealing with such issues.
  2. Students should have experiences in selecting and organizing information in order to draw intelligent conclusions from it. For sound judgements to be made, information regarding controversial issues should:
    - (a) represent alternative points of view,
    - (b) appropriately reflect the maturity, capabilities and educational needs of the students and reflect the requirements of the course as stated in the program of studies.

- (c) reflect the neighborhood and community in which the school is located, but not to the exclusion of provincial, national and international contexts.
3. School trustees should establish, in consultation with appropriate interest groups, policies regarding:
- (a) identification of controversial issues,
  - (b) treatment of such issues in local classrooms.
4. Students, teachers and administrative staff should have a voice in determining:
- (a) the controversial issues to be studied,
  - (b) the texts and other materials to be used,
  - (c) the manner in which such issues are dealt with in the classroom.

## CHANGES IN LEGISLATION RELATIVE TO LOCAL SELECTION OF INSTRUCTIONAL MATERIALS AND DEVELOPMENT OF CURRICULA

NOTE: The following notices take precedence over two previous announcements entitled "Ministerial Order Relative to Section 13 of *The School Act*", which appeared in the December 1970 and January 1974 issues of the Curriculum Bulletin (Vol. IV No. 1, and Vol. VII No. 1).

### A. Instructional Materials Delegation Order

The Ministerial Order dated June 23, 1970 has been replaced by the following Regulation (224/75):

#### THE SCHOOL ACT REGULATIONS DELEGATING POWERS TO SCHOOL BOARDS

1. In this regulation "Act" means **The School Act**.
2. A board may prescribe instructional materials in addition to, or in substitution for, those instructional materials prescribed for use under section 12, subsection (2), clause (a), subclause (ii) of the Act.
3. Where a board prescribes instructional materials under section 2, it shall do so by resolution of the board.
4. A copy of a resolution made under section 2 shall be sent to the Minister.

### B. Amendment to Section 12 (2) (b) of The School Act.

**The School Amendment Act, 1975** includes the following amendment:

Section 12, subsection (2) is amended by striking out clause (b) and substituting the following clause:

[The Minister may:]

- (b) approve any course of study or pupil program submitted to him by a board, but instruction in the course of study or pupil program shall not commence without the prior approval of the Minister in writing.

### C. Department of Education Policy Statement Relative to Curriculum Development and Sections 12 and 13 of the Revised School, Act, 1970.

- (a) As indicated in the revised Act, courses of study will be prescribed. However, the nature of this prescription will tend to be broad and will consist of statements of objectives as well as statements of minimum content expressed in terms of concepts, processes, experiences or skills. While such courses will form the basis for instruction, it is expected that within the framework of the prescribed courses, many decisions will be made at the district, school and

classroom level in order to meet the needs of particular groups of students as well as the needs of individual students.

- (b) In those cases where the nature of the prescription by the Minister is very broad, such as academic options in the junior high school or special projects in the senior high school, teachers and principals are responsible to the school board through the administration staff for all activities undertaken and for all materials used in carrying forward the course or project.

- (c) For the purposes of communication, courses of study will be identified by grade level in the elementary and junior high school and by course number for the senior high school. This method of identification does not suggest the grade method of organization has any particular advantage. In fact, school districts and schools are encouraged to develop methods of organization which best meet the needs of their students in terms of continuous development within the constraints of available human, physical and financial resources. At the senior high school level, any departure from the course and variable credit organization must involve some type of credit equivalents in order that the provincial high school diploma might be awarded on some equitable basis.

- (d) With respect to section 12 (2) (b) of **The School Amendment Act, 1975**, it is expected that requests from school boards to the Minister will involve only those situations where the proposed course of study or pupil program is substantially or completely different from courses prescribed by the Minister. Requests to the Minister should normally contain:

- (i) the objectives of the course or program
- (ii) the course outline stated in terms of concepts, processes, experiences or skills
- (iii) the instructional materials to be used
- (iv) the prospective enrolment
- (v) special facilities or equipment necessary to offer the course or program
- (vi) proposals for evaluation of the course or program

(e) Textbooks used in a school system must be either those prescribed by the Department of Education or by the school board. Other materials may also be prescribed by resolution of the board. Some teachers, however, may use no textbooks but rather a variety of print and non-print materials. When this is the case, the teacher is responsible for the use of any materials not prescribed by the school board.

**D. Note Regarding Procedures for Locally Developed Courses**

In 1974, the Secondary Curriculum Board passed a motion that locally developed courses should be re-

viewed by the appropriate policy committee before being submitted to the Curriculum Board. Therefore, it would appear advantageous for local systems to notify the Curriculum Branch early in the development stages of proposed programs. In cases in which both local and provincial priorities may be served, consultative and financial assistance may be forthcoming.

Also, **The School Amendment Act, 1975** stipulates that instruction of a locally developed course shall not commence without prior approval of the Minister, in writing. Schools may not award credits for any locally developed course unless they, or their school system, have been granted authority by the Minister of Education to offer that course.

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